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NEW THALASSINIDEAN SHRIMP FROM THE PACIFIC OCEAN (CRUSTACEA: DECAPODA: AXIIDAE AND CALOCARIDIDAE)

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ABSTRACT

One new genus (*Marianaxius*) and seven new species of axiid shrimps, and one new calocaridid species are recorded from scattered sites around the Pacific Ocean. The axiid species include *Axiopsis bythos* from the Philippines; *Bouvieraxius springeri* from the Sulu Sea; *Eiconaxius albatrossae* from Pacific Panama; *Eiconaxius baja* from Baja California; *Eiconaxius kimbla* from Queensland, Australia; and *Marianaxius kroppi* from Guam. *Eiconaxius cristagalli* (Faxon), originally described from Pacific Panama, is recorded from the Galapagos Islands. The new species of calocaridid, *Ambiaxius japonicus,* is recorded from Japan.

The axiid and calocaridid fauna of the Pacific Ocean is known from numerous scattered works, major contributions including De Man (1925), Poore and Griffin (1979), Sakai and de Saint Laurent (1989), Sakai (1992), and Poore (1994). Given the size of the Pacific and the relatively small area thus far sampled, it can safely be assumed that only a small percentage of the fauna has been described; not surprisingly, new forms continue to be found. Most of the material described in this paper has accumulated over the course of many years in the collections of the National Museum of Natural History, Smithsonian Institution. Five of the species were collected in the late 19th and early 20th century by the U.S. Bureau of Fisheries steamer ALBATROSS. Specimens of single species were collected by biologists in the course of fish or general crustacean collecting, while one species was sent as a loan from the Australian Museum. Abbreviations: AM—Australian Museum; cl—carapace length; MCZ—Museum of Comparative Zoology, Harvard University; ovig.—ovigerous; USNM—National Museum of Natural History, Smithsonian Institution.

SYSTEMATICS

Family Axiidae

Genus *Axiopsis* Borradaile, 1903

Axiopsis australiensis De Man, 1925. New South Wales, Victoria, Australia, intertidal.

Axiopsis baronai Squires, 1977. Pacific Colombia, 7–9 m; Peru; Gulf of California, Mexico.

Axiopsis bythos, new species. Off Philippines, 510 m.

Axiopsis consobrina De Man, 1905. Sulu Sea, 275 m; Buton Straits and Solor Straits, 75–113 m; Gulf of Carpentaria, Australia, 27 m.

Axiopsis serratifrons (A. Milne Edwards, 1873). PACIFIC OCEAN: Hawaii; Palmyra Is.; Gilbert Is., intertidal; Trobriand Islands, 0–8 m.; Bikini Atoll, intertidal; Kwajalein Atoll, 1.2 m; Samoa; Palau; Guam, intertidal—15 m; Fanning Is.; Noordwachter Is.; Ambon Is.; Obi Is.; Damar Is.; Lucipara Is.; Kur Is.; Roti Is.; Kapingamarangi Atoll; Jarvis Island; Philippines, 0–17 m; Mexico; Colombia. INDIAN OCEAN: Maldive Is.; Chagos Archipelago; Aldabra Atoll, intertidal; Obock, Red Sea; Zululand, South Africa, 18 m. ATLANTIC OCEAN: Bermuda, 10 m; Ascension Island, intertidal-8 m; Belize, 1–14 m; Florida Keys, 1–6 m; Tobago, 10 m.

Axiopsis tsushimaensis Sakai, 1992. Tsushima Islands, Korea Strait, 102 m.

Axiopsis werribee Poore and Griffin, 1979. Victoria, Tasmania, Australia, 10–25 m.

Axiopsis bythos new species
Figure 1, Table 1

Material Examined.—Holotype, USNM 243508, ♂ cl 8.5 mm, ALBATROSS sta 5536, 19 Aug 1909, off Apo Is., Philippines, 9°15′45″N, 123°22′00″E, 510 m, green mud bottom. *Paratypes,* USNM

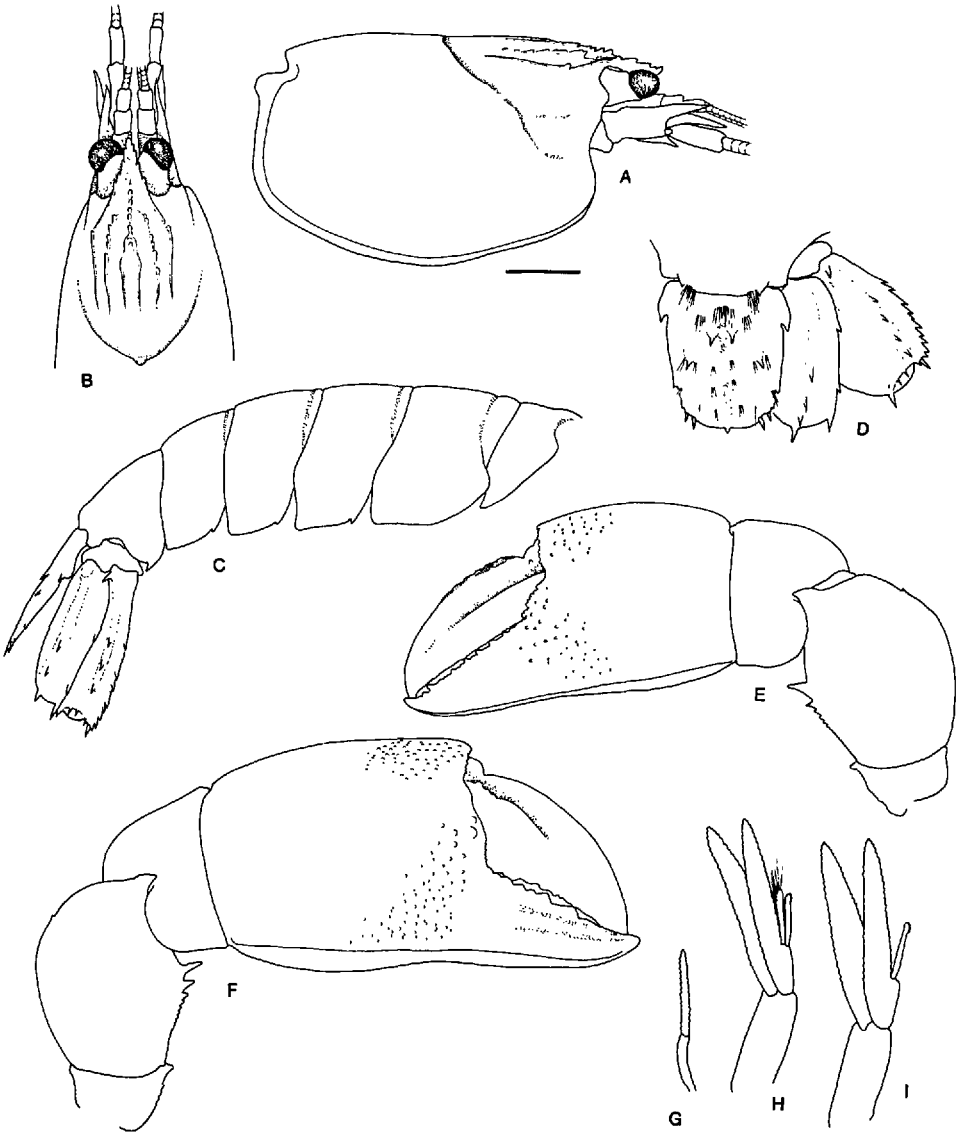

Figure 1. *Axiopsis bythos*, USNM 243508: A, carapace in lateral view, scale = 2 mm; B, anterior carapace in dorsal view; C, abdomen in lateral view; D, telson and right uropod; E, pereopod 1, smaller cheliped; F, pereopod 1, larger cheliped; G, pleopod 1 ♀; H, pleopod 2 ♂; I, pleopod 3.

Table 1. Branchial and exopod formula for *Axiopsis bythos*

	Maxillipeds			Pereopods				
	1	2	3	1	2	3	4	5
Exopod	1	1	1	—	—	—	—	—
Epipod	—	1	1	1	1	1	1	—
Podobranch	—	1	1	1	1	1	—	—
Arthrobranch	—	—	2	2	2	2	2	—
Pleurobranch	—	—	—	—	—	—	—	—
Setobranch	—	—	1	1	1	1	1	1

243509, 4 ovig. ♀ cl 9.1 mm, 9.4 mm, 6.3 mm, 5.9 mm, non-ovig. ♀, cl 6.5 mm, same locality data as holotype.

Diagnosis.—Carapace glabrous. Rostrum just overreaching cornea, bearing 4 teeth on lateral margins, apex slightly upturned, margins continued posteriorly to form lateral carina bearing single tooth; median carina starting at base of rostrum, bearing 5 low teeth anterior to median tubercle, dividing posterior to tubercle into 2 subparallel carinae reaching posteriorly as far as submedian and lateral carinae; submedian carina bearing 5–6 low teeth. Abdominal pleuron 1 ventrally narrowed, apically acute; pleuron 2 broad, ventrally convex; pleura 3–5 similar, bearing small denticle on anterior margin, posteroventral angle subacute; pleuron 6 with acute posteroventral tooth.

Mouthparts typical of genus. Maxilliped 3, merus bearing 2 strong teeth on posterior margin; posterior margin of ischium unarmed, crest with about 35 fine denticles. Pereopod 1, larger chela, ischium with few low tubercles on posterior margin; merus strongly convex dorsally, with 3 or 4 teeth and several denticles decreasing in size proximally on posterior margin, anterior margin with single small tooth; carpus unarmed; propodal palm dorsally and ventrally carinate, width about ⅔ length measured to base of fingers, slightly less than twice length of fingers, with dorsal and ventral patches of tiny tubercles on outer surface, fixed finger with about 7 low rounded tubercles on cutting edge; dactyl with few low proximal tubercles on cutting edge. Pereopod 1, smaller chela, ischium, merus, and carpus as in larger chela; propodal palm dorsally and ventrally carinate, subequal in length to fingers, with dorsal and ventral patches of tiny tubercles on outer surface, fixed finger with row of 7–8 low teeth on cutting edge; dactylus with few low serrations on upper margin, cutting edge finely denticulate. Pereopod 2, merus lacking spination. Pereopod 3, merus with 3 low teeth on posterior margin. Coxae of pereopods 1–4 with 1 or 2 teeth on mesial margin. Pleopod 1 in female of 2 slender articles; lacking in male. Pleopod 2 of male with subequal appendix masculina and appendix interna articulating at about proximal fourth of endopod. Pleopods 3–5 with rami subequal in length, endopod bearing appendix interna. Uropod with lateral ramus armed with 10 teeth on lateral margin, mobile spine at outer angle of suture, latter with 2 or 3 small teeth, strong marginal tooth at inner angle of suture; lateral ridge on dorsal surface bearing 4 teeth; mesial ramus, lateral margin bearing 3 teeth (including distolateral one); dorsal ridge bearing 4 distal teeth (including distalmost marginal one). Telson, median length subequal to greatest width, lateral margin with 3 teeth, 2 mobile spines at posterolateral angle; posterior margin convex, with median point; 2 pairs of strong teeth on dorsal surface.

Remarks.—This species is somewhat reminiscent of species of the sponge commensal genus *Eiconaxius,* especially in the shape of the rostrum and the chelipeds of pereopod 1. Further, the depth from which it was taken would be more in line with the latter than with *Axiopsis* (no mention is made of sponges in the ALBATROSS records for this station). Nevertheless, it is placed in *Axiopsis,* given a branchial formula that agrees with typical *Axiopsis,* i.e. lacking pleurobranchs, the presence of a suture on the lateral uropodal ramus, the lack of pleopod 1 in the male, and an elongate antennal acicle. Using Poore (1994), the species keys out to *Axiopsis.*

Axiopsis bythos differs from the widespread *A. serratifrons* in three easily seen features, viz. in having a far less tuberculate anterior carapace, in the more spinose lateral uropodal ramus, and in the more robust chelipeds of pereopod 1. Compared with *A. bythos, Axiopsis tsushimaensis* has a more spinose anterior carapace and

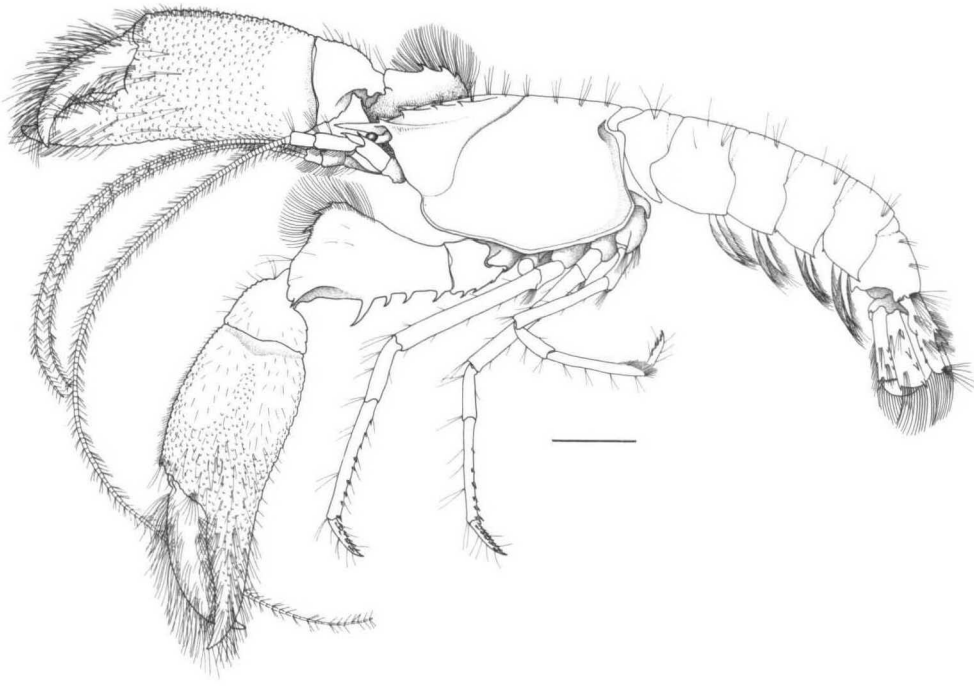

Figure 2. *Bouvieraxius springeri,* holotype, USNM 243510, scale = 5 mm.

rostrum, a more spinose ischium and merus of pereopod 1, and a less spinose lateral uropodal ramus. *Axiopsis werribee* lacks spines on the lateral and submedian carinae of the anterior carapace, whereas *Axiopsis consobrina* is more spinose on the anterior carapace than *A. bythos.* The intertidally occurring *Axiopsis australiensis* lacks real spines on the anterior carapace, rather having numerous small rounded tubercles, while the uropodal rami are far less spinose.

Etymology.—The specific name is the Greek for "from the deep," and refers to the deep habitat of the species, relative to that of most of its congeners.

Genus *Bouvieraxius* Sakai and de Saint Laurent, 1989

Species:

Bouvieraxius keiensis Sakai, 1992. Kei Islands, 245 m; off Mauritius, 73 m.
Bouvieraxius longipes (Bouvier, 1905); Barbados, 225 m.
Bouvieraxius rudis (Rathbun, 1906); Hawaii, 73–426 m.
Bouvieraxius springeri, new species. Sulu Sea, 0–14 m.

Bouvieraxius springeri, new species
Figures 2, 3, Table 2

Material Examined.—Holotype, USNM 243510, 1 ?♂ cl 12.5 mm, Sulu Sea, 10°52′30″N, 120°56′00″E, 0–14 m, coll. V. Springer, 23 May 1978.

Diagnosis.—Carapace surface smooth, with fine scattered setae; 1 pair rostral teeth (supraocular); median carina unarmed; 3 teeth on submedian carina; lateral carina unarmed. Abdominal pleuron 1 narrow, ventrally acute; 2 posteroventrally quadrate; 3–5 becoming more acute posteriorly, each with small marginal denticle on anterior margin.

Maxilliped 3, ischium with 2 teeth on posterior margin; merus with 1 strong

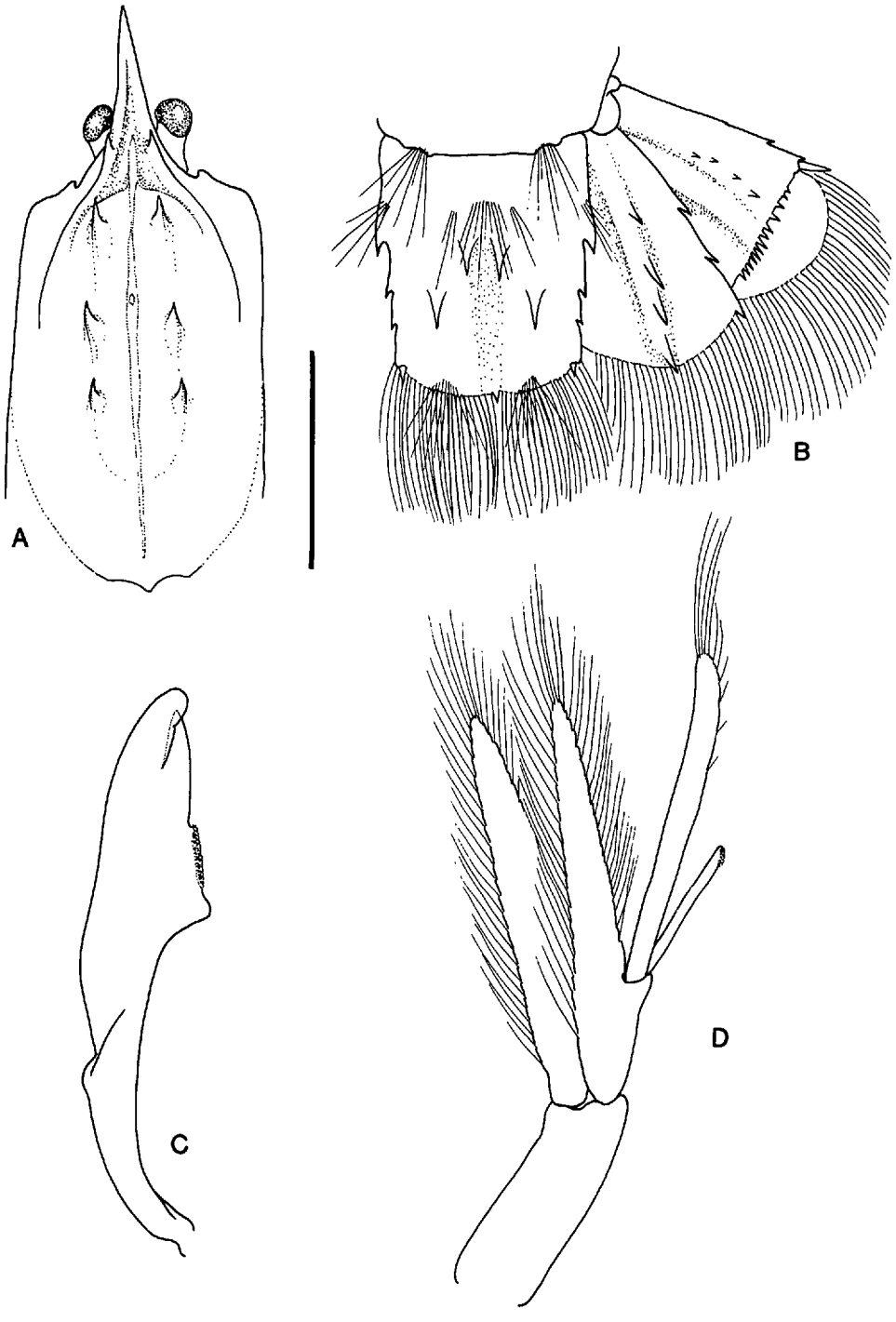

Figure 3. *Bouvieraxius springeri,* holotype, USNM 243510: A, anterior carapace in dorsal view, scale = 5 mm; B, telson and right uropod; C, pleopod 1 ♂; D, pleopod 2 ♂.

Table 2. Branchial and exopod formula for *Bouvieraxius springeri*

	Maxillipeds			Pereopods				
	1	2	3	1	2	3	4	5
Exopod	1	1	1	—	—	—		—
Epipod	1	1	1	1	1	1	—	—
Podobranch	—	1	1	1	1	1	1	—
Arthrobranch	—	1	2	2	2	2	—	—
Pleurobranch	—	—	—	—	1	1	2	—
Setobranch	—	—	1	1	1	1	1	—

distal and 2 much smaller spines on posterior margin. Pereopod 1, larger chela: ischium with 1 large distal and 2 small proximal spines on posterior margin; merus with 4 spines on proximal posterior margin, distalmost largest; single strong posterodistal spine; dorsal (anterior) margin carinate, strongly crested, crest bearing 3 spines plus band of finely fringed setae; carpus with dorsal margin serrulate; propodus with almost entire inner and outer surface bearing fairly close-set rounded tubercles and extending onto base of fixed finger, dorsal palm about 1.4 times length of fingers, fixed finger with low triangular cusp at about midlength; dactylus cutting edge concave, entire; both fingers bearing dense silky simple setae. Pereopod 1, smaller chela: ischium, merus, and carpus as in larger chela; propodus with dorsal palm slightly longer than fingers, fixed finger with low triangular cusp in proximal half, remainder of cutting edge irregularly denticulate; dactylus with few proximal tubercles on cutting edge, distally entire; both fingers setose as in larger chela. Pereopod 2 missing on both sides. Pleopod 1 with distal half expanded, apically with rounded lateral lobe and shorter subacute mesial lobe. Pleopod 2, endopod with appendix masculina and appendix interna articulating at proximal third of length; appendix masculina extending distally beyond apices of rami, slender, club-shaped, distally rounded and setose; appendix interna slender, about half length and width of appendix masculina. Uropodal lateral ramus with 3 spines on outer margin, strong distal submarginal mobile spine; suture with 14 spines, 4 spines on dorsal surface; mesial ramus with 3 spines on outer margin, 4 spines on dorsal surface including distal submarginal spine. Telson having 3 fixed marginal spines, single posterolateral mobile spine, single posteromedian spine, 2 pairs submedian dorsal spines.

Remarks.—Even though only a single specimen of this species was captured, it was thought to be so distinctive as to warrant description. While the specimen fits the definition of *Bouvieraxius,* (Sakai and de Saint Laurent, 1989: 45; Poore, 1994: 97), the strongly crested dorsal margin and dense fringe of setae of the merus in both chelipeds of pereopod 1 immediately separate *B. springeri* from the three previously described species.

Etymology.—The species is named for Dr. Victor Springer of the Division of Fishes, National Museum of Natural History, who collected the single specimen.

Genus *Eiconaxius* Bate, 1888

Remarks.—The species of *Eiconaxius* are morphologically quite similar. All possess a relatively large "cutting" chela of which the curved fingers are usually longer than the palm, cutting edges very finely serrate, and a "crushing" chela in which the palm is usually as long or longer than the fingers. The crushing chela usually has a basal tubercle followed by small teeth on the propodal fixed finger, and a large basal tubercle followed by a notch, a large tooth, and several

smaller teeth distally on the dactylus. Differences between species are subtle, and their separation is complicated by the paucity of material from any area, making an assessment of variation difficult. Dentition of the median carina and rostral margins, relative development of the submedian and lateral carinae, shape of the abdominal pleura, and proportions of the chelae of pereopod 1 are used here in species separation. (Length of fingers of the chelae is measured from tip to base of the dactyl.)

Species of *Eiconaxius* have been recorded from several hexactinellid sponges (Faxon, 1896; Bouvier, 1925); the evidence seems to indicate that all members of this genus are sponge commensals. Whether there is a species-specific relationship between shrimp and sponge is unknown.

In the following treatments of species of *Eiconaxius,* only *E. albatrossae* has been fully illustrated; for the remaining species, only diagnostic features are illustrated, mouthparts and walking legs being very similar in all species.

Species:

Eiconaxius acutifrons Bate, 1888. Off Banda, Indonesia, 658 m.
Eiconaxius agassizi Bouvier, 1905. Cuba; Dominica; Barbados; Haiti; Grenada; Yucatan Peninsula; Florida Keys; 183–1574 m.
Eiconaxius albatrossae, new species. Pacific Panama, 851–1016 m.
Eiconaxius andamanensis (Alcock, 1901). Off Andaman Islands, Indian Ocean, 530 m.
Eiconaxius antillensis Bouvier, 1905. Montserrat; Barbados; St. Lucia; Guadeloupe; Jamaica; Gulf of Mexico; 161–1065 m.
Eiconaxius asper Rathbun, 1906. Hawaii, 765–966 m.
Eiconaxius baja, new species. Gulf of California, 1252 m.
Eiconaxius borradailei Bouvier, 1905. Cuba; Barbados; 194–324 m.
Eiconaxius caribbaeus (Faxon, 1896). Barbados; St. Vincent; Cariacou; Guadeloupe; St. Lucia; St. Croix; Yucatan Peninsula; 161–622 m.
Eiconaxius consobrinus (De Man, 1907). Off Timor, Indonesia, 1280 m.
Eiconaxius cristagalli (Faxon, 1893). Pacific Panama, 851 m; Galapagos Islands, 717 m.
Eiconaxius demani Sakai, 1992. Kei Islands, 352–385 m; Arafura Sea, 390 m.
Eiconaxius farreae (Ortmann, 1891). Japan, 183–598 m.
Eiconaxius indicus (De Man, 1907). Indonesia, 984 m.
Eiconaxius kermadeci Bate, 1888. Kermadec Islands, 1098 m.
Eiconaxius kimbla, new species. Off Queensland, Australia, 140–148 m.
Eiconaxius laccadivensis (Alcock, 1901). Arabian Sea off Laccadive Islands, 786–1290 m.
Eiconaxius mortenseni Sakai, 1992. Sagami Bay, Japan, 366–732 m.
Eiconaxius parvus (Bate, 1888). Off Kermadec Islands, 1098 m.
Eiconaxius sibogae De Man, 1925. Sulu Sea, 520 m.
Eiconaxius singularis Zarenkov, 1981. North-west Pacific, 1000–1350 m.
Eiconaxius spinigera (MacGilchrist, 1905). Bay of Bengal, 1756 m.
Eiconaxius weberi (De Man, 1905). Off Kai Island, Indonesia, 594–984 m.

Eiconaxius albatrossae, new species
Figures 4, 5

Material Examined.—Holotype, MCZ 4568, ♂ cl 7.3 mm, ALBATROSS sta 3359, 24 Feb 1891, 6°22′20″N, 81°52′00″W, Pacific Panama, 851 m. *Paratypes,* MCZ 4568, 3 ♂, cl 7.1 mm, 7.2 mm, 7.2 mm, 2 ovig. ♀ cl 5.9 mm, 7.2 mm, same locality.—USNM 21063, 2 ♂ cl 6.2 mm, 7.1 mm, 4 ovig. ♀, cl 7.3 mm, 7.8 mm, 7.8 mm, ALBATROSS sta 3358, 24 Feb 1891, 6°30′00″N, 81°44′00″W, Pacific Panama, 1016 m.

Diagnosis.—Rostrum lanceolate, apically narrowly rounded to subacute; margins dentate anteriorly from above eye. Median carina entire. Submedian carinae poorly defined, entire. Lateral carina reaching posteriorly for distance greater than rostral length, entire. Pleura 2–4 ventrally narrowly acute, pleuron 5 ventrally rounded, pleuron 6 short, with ventral tooth.

Eye lacking pigment. Mandibular palp with third article longest, setose lateral margin curved; cutting blade evenly curved, with low proximal rounded ridge.

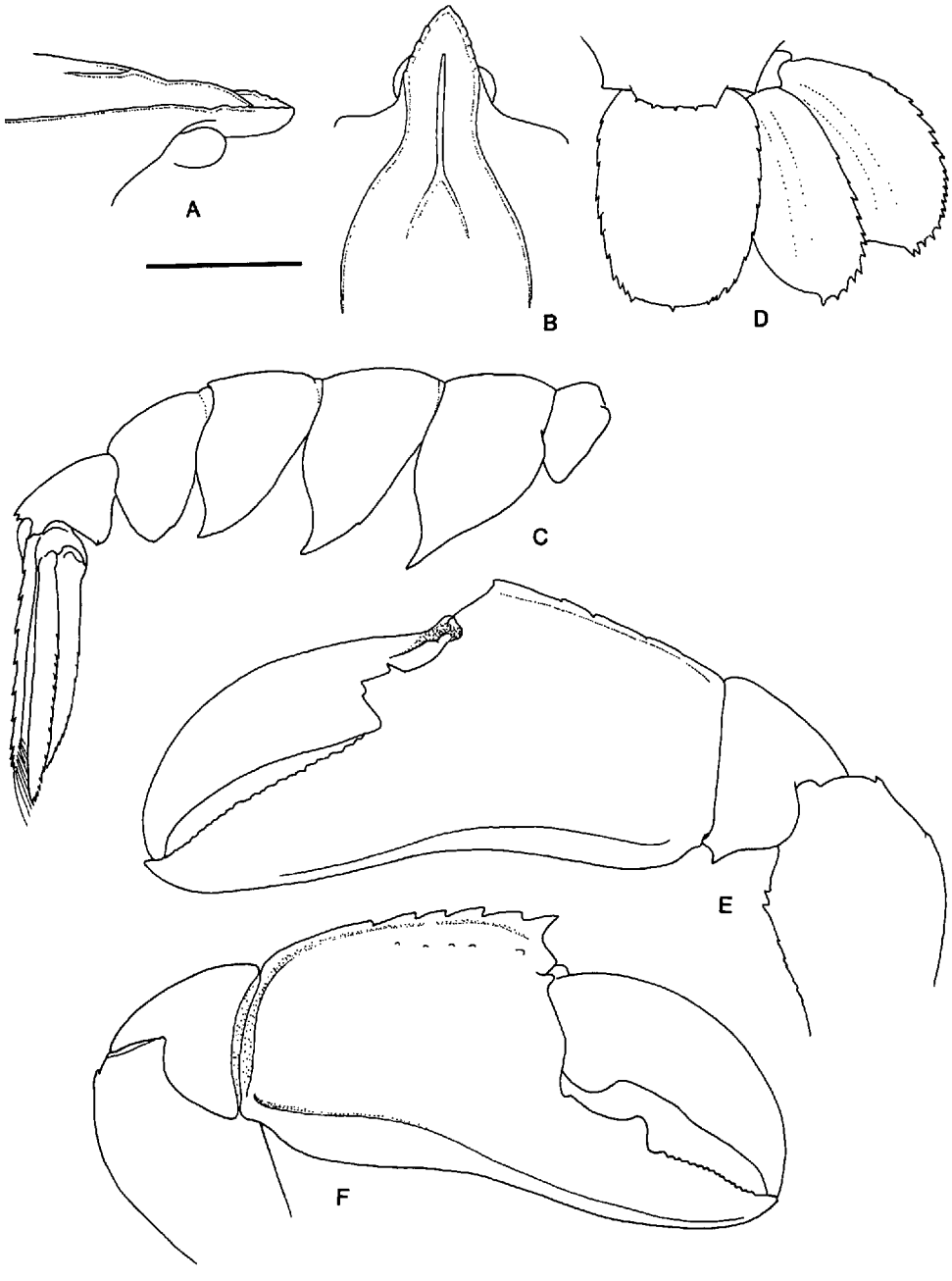

Figure 4. *Eiconaxius albatrossae*, holotype, MCZ 4568: A, anterior carapace in lateral view; B, anterior carapace in dorsal view, scale = 2 mm; C, abdomen in lateral view; D, telson and right uropod; E, pereopod 1, cutting chela; F, pereopod 1, crushing chela.

Maxilla 1 exopod of 2 articles, distal article sickle-shaped. Maxilla 2 exopod distally tapered. Maxilliped 1 with large bilobed epipod; exopod broad, curved, with small distal article; endopod slender, less than half length of exopod. Maxilliped 2 dactylus bearing several stiff spines; strong exopod present. Maxilliped

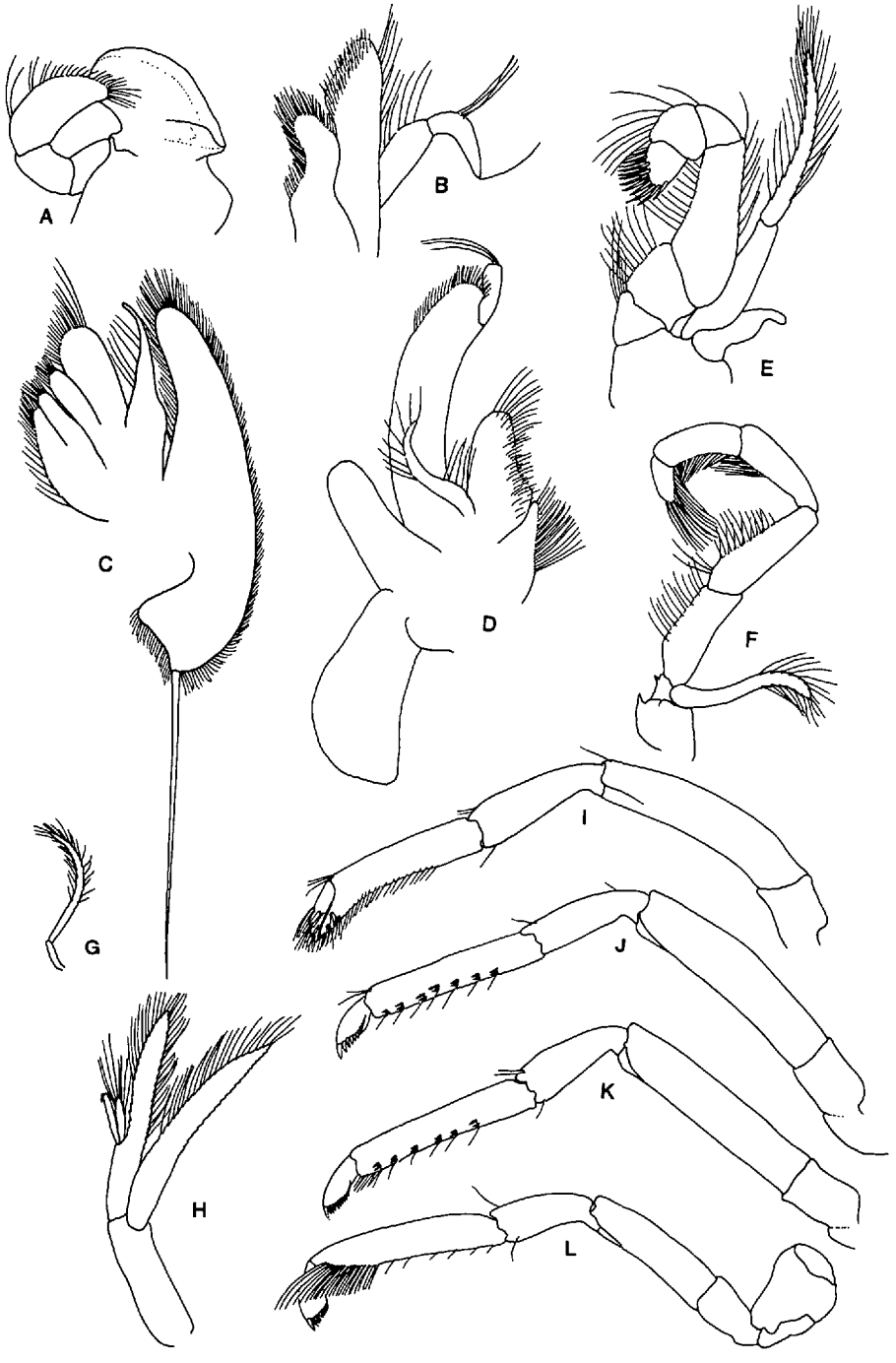

Figure 5. *Eiconaxius albatrossae:* A, mandible; B, maxillule; C, maxilla; D, maxilliped 1; E, maxilliped 2; F, maxilliped 3; G, pleopod 1 ♀; H, pleopod 2 ♂; I, pereopod 2; J, pereopod 3; K, pereopod 4; L, pereopod 5.

3, ischial crest bearing about 18 denticles. Cutting chela with fingers subequal to palm in length; upper margin of propodal palm serrate; dentate lobe at base of fixed finger variable, with 2–5 teeth. Crushing chela subequal in length to propodal palm; upper margin of palm strongly serrate. Pereopods 2–4 of similar length; pereopod 2 with setose chela slightly flexed, about ¼ length of propodus; pereopods 3 and 4 having series of short spines on posterior surface of propodus; pereopod 5 with posterodistal brush of stiff grooming setae on propodus. Pleopod 1 in female slender, uniramous, consisting of short proximal article and elongate flagelliform distal article. Pleopod 1 in male absent. Pleopod 2 in male with appendix interna and slightly shorter setose appendix masculina articulating at about proximal third of endopod. Uropodal lateral ramus with about 20 serrations on lateral margin; mesial ramus with about 12 serrations on lateral margin. Telson greatest width about ¾ mesial length, with about 11 serrations on lateral and posterolateral margin; tiny posteromedian tooth present.

Remarks.—See Remarks section after *E. baja.*

Etymology.—The specific name is derived from the R.V. ALBATROSS, the ship used in the collection of the material.

Eiconaxius baja new species
Figure 6, Table 3

Material Examined.—Holotype, USNM 211493, ♂ cl 10.8 mm, ALBATROSS sta 2986, 28 Feb 1889, Baja California, 28°57′00″N, 118°14′30″W, 1252 m, sponge fragments in sample. *Paratypes,* USNM 211495, 3 ♂, cl 8.9 mm, 9.1 mm, 10.2 mm, 6 ovig. ♀ cl 8.5 mm, 9.1 mm, 9.3 mm, 9.5 mm, 10.4 mm, 10.5 mm, ♀ cl 8.8 mm, same locality data.

Diagnosis.—Rostrum lanceolate, apex upturned and acute; margins dentate anteriorly from above eyes. Median carina entire. Submedian carinae short, entire. Lateral carina longer than rostrum, entire. Pleura 2–4 ventrally narrowed, subacute, pleuron 5 ventrally rounded, pleura 3–5 with variable number (1–3) teeth on anterior margin, more marked in male than in female.

Eyes lacking pigment. Mouthparts as in *E. albatrossae.* Cutting chela, fingers about twice length of propodal palm, latter with scattered setose tubercles on outer surface, upper margin strongly serrate; dentate lobe at base of fixed finger bearing 3–5 teeth. Crushing chela, fingers subequal to propodal palm in length, inner and outer surface of palm tuberculate; upper margin of palm strongly serrate. Pereopods 2–5 essentially similar to those of *E. albatrossae.* Lateral ramus of uropod with about 20 serrations on lateral margin; mesial ramus with about 12 serrations on lateral margin. Telson with greatest width about ⅘ medial length; about 13 serrations on lateral and posterolateral margin; small posteromedial tooth present.

Remarks.—The only species of *Eiconaxius* previously recorded from the northeast Pacific is *E. cristagalli* (Faxon, 1893), known from Pacific Panama and recorded from the Galapagos Islands in this paper. *Eiconaxius albatrossae,* the second species from Pacific Panama, differs from the earlier species in having an entire median carina and the anterior margin of the propodal palm of pereopod 1 dentate. *Eiconaxius baja* from further north is a larger species (ovig. ♀ cl 8.5–10.5 mm) than *E. albatrossae* (ovig. ♀ cl 5.9–7.8 mm), and is further distinguished by having a noticeably upturned rostral apex, and by the lateral surface of the propodal palm of pereopod 1 bearing strong setose tubercles.

Etymology.—The specific name is derived from the type locality, Baja California.

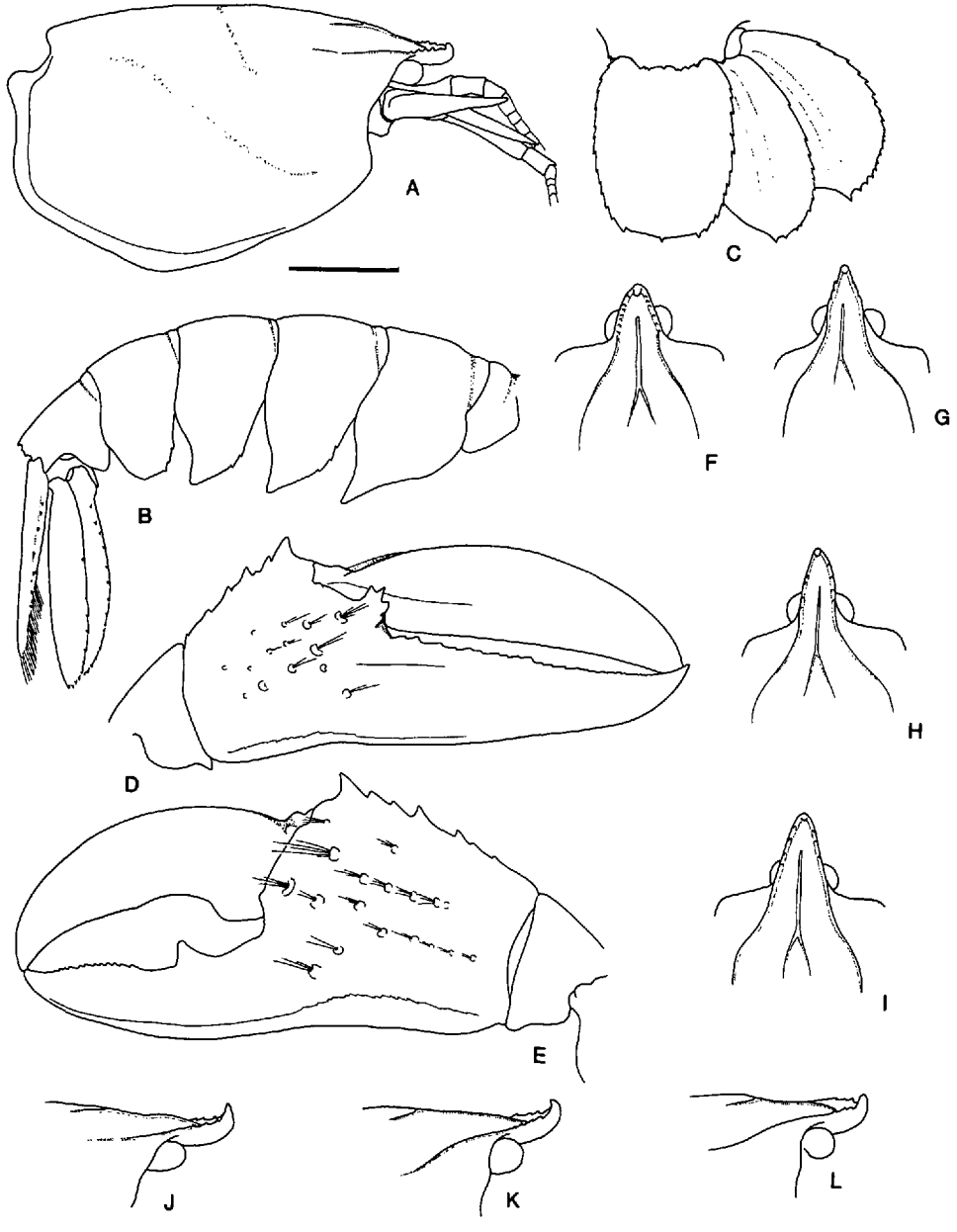

Figure 6. *Eiconaxius baja,* holotype, USNM 211493: A, carapace in lateral view, scale = 3 mm; B, abdomen in lateral view; C, telson and right uropod; D, pereopod 1, cutting chela; E, pereopod 1, crushing chela; F, anterior carapace, ♂ cl 10.8 mm; G, anterior carapace, ♂ 10.2 mm; H, anterior carapace, ovigerous ♀ cl 10.4 mm; I, anterior carapace, ovigerous ♀ cl 10.5 mm; J, anterior carapace, ovigerous ♀ cl 10.5 mm; K, anterior carapace, ovigerous ♀ cl 10.4 mm; L, anterior carapace, ♂ cl 10.2 mm.

Table 3. Branchial and exopod formula for *Eiconaxius baja*

	Maxillipeds			Pereopods				
	1	2	3	1	2	3	4	5
Exopod	1	1	1	—	—	—	—	—
Epipod	1	1	1	1	1	1	1	—
Podobranch	—	—	1	1	1	1	—	—
Arthrobranch	—	—	2	2	2	2	2	—
Pleurobranch	—	—	—	—	1	1	1	—
Setobranch	—	—	1	1	1	1	1	—

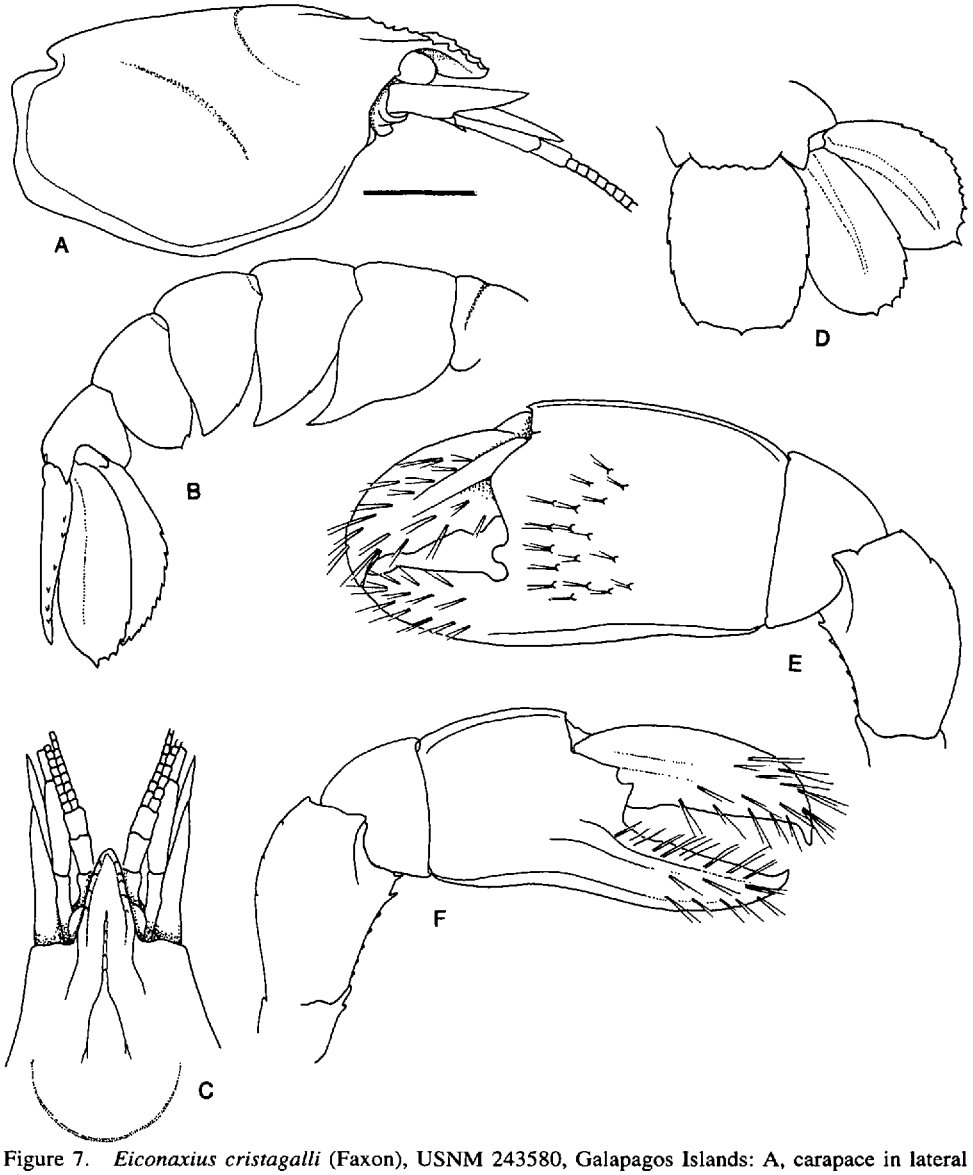

Figure 7. *Eiconaxius cristagalli* (Faxon), USNM 243580, Galapagos Islands: A, carapace in lateral view, scale = 2 mm; B, abdomen in lateral view; C, anterior carapace in dorsal view; D, telson and right uropod; E, pereopod 1, crushing chela; F, pereopod 1, cutting chela.

Eiconaxius cristagalli (Faxon, 1893)
Figure 7

Axius crista-galli Faxon, 1893:193; 1895:104, pl. 28, fig. 1.—De Man, 1925:4, 31.
Eiconaxius crista-galli.—Rathbun, 1906:895.
Axius (Eiconaxius) crista-galli.—Borradaile, 1903:538.
Eiconaxius cristagalli.—Sakai and de Saint Laurent, 1989:2, 16, 18, 101.

Material Examined.—*Syntypes,* MCZ 45569, 3 ♂ cl 5.8 mm, 5.9 mm, 8.0 mm, ovig. ♀ cl 8.3 mm, ALBATROSS sta 3359, 6°22′20″N, 81°52′00″W, off Pacific Panama, 851 m, rocky bottom.

Additional Material.—USNM 243580, 8 ♂ cl 5.2 mm, 5.4 mm, 5.8 mm, 5.8 mm, 6.0 mm, 6.0 mm, 6.1 mm, 6.6 mm; 3 ovig. ♀ cl 5.9 mm, 6.1 mm, 6.5 mm; 2 ♀ cl 5.6 mm, 6.0 mm, ALBATROSS sta 2818, off Galapagos Islands, 0°29′00″S, 89°54′30″W, 717 m, 15 Apr 1888.

Diagnosis.—Rostrum lanceolate, apex slightly upturned; margins having 4–5 irregular teeth anteriorly from above eye. Median carina having about 5 irregular teeth. Lateral carina entire posterior to eye. Pleura 2–4 ventrally narrowed, apically acute, 3 and 4 having tiny denticles on anterior margin. Pleuron 5 ventrally broad, with 1–2 tiny denticles on anterior margin.

Eyes lacking pigment. Mouthparts as in *E. albatrossae.* Maxilliped 3 ischial crest bearing 12–13 denticles. Pereopod 1, merus with 4 low denticles on upper margin, about 9 serrations on lower margin; cutting chela with fingers subequal in length to propodal palm; latter with strong, acute, entire upper carina ending distally in tiny tooth, lateral surface smooth, with bidentate lobe at base of fixed finger; mesial surface having numerous setose tubercles and bidentate lobe at base of fixed finger. Crushing chela, fingers shorter than propodal palm, latter with strong, acute, entire carina on upper margin ending distally in tiny tooth, lateral surface having several setose tubercles, with peg-like tubercle at base of fixed finger; mesial surface with several setose tubercles and three denticles at base of fixed finger. Pereopods 2–5 essentially similar to those of *E. albatrossae.* Lateral ramus of uropod with about 13 serrations on lateral margin; mesial ramus with about 7 serrations on lateral margin. Telson with greatest width at midlength; about 7 or 8 serrations on lateral and posterolateral margin; small posteromedian tooth present.

Remarks.—No differences could be detected between the syntypic material from Pacific Panama and the Galapagos material, even though these sites are about 1,000 miles apart. This is the only species of *Eiconaxius* thus far recorded from the Galapagos Islands.

Eiconaxius kimbla new species
Figure 8

Material Examined.—*Holotype,* AM P-25015, ovig. ♀ cl 4.1 mm, *Kimbla* sta 6/69-1, 9 miles off Moreton Bay, Queensland, 27°06′S, 153°37′E, 140–148 m. *Paratypes,* AM P-25015, 2 ♂ cl 3.4 mm, 4.0 mm, ♀ cl 4.1, same data as holotype.—*Paratype,* USNM 243595, ♂ cl 4.1 mm, same data as holotype.

Diagnosis.—Rostrum lanceolate, apically narrowly rounded to subacute; margins unarmed, faintly irregular. Median carina unarmed. Submedian carinae shorter than median carina, unarmed. Lateral carina extending posteriorly well beyond base of rostrum, unarmed. Pleura similar in both sexes; pleuron 1 short, ventrally rounded; pleuron 2 broadest, posteroventral corner nearly a right-angle; pleura 3–5 each with small denticle on anteroventral margin; pleuron 6 short, with ventral denticle.

Eyes (in preservative) faintly pigmented. Mouthparts essentially as in *E. al-*

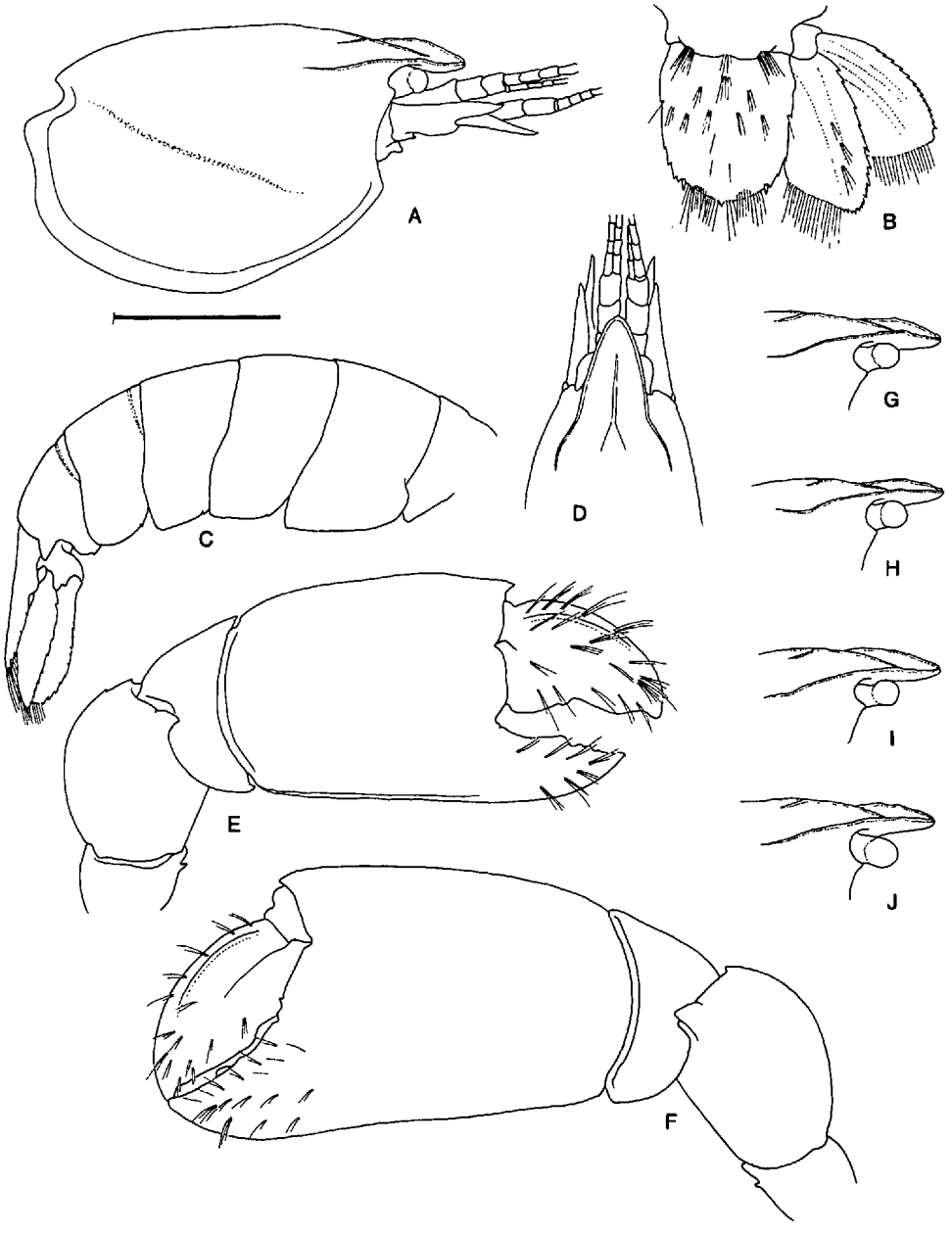

Figure 8. *Eiconaxius kimbla,* AM-P 25015: A, carapace in lateral view, scale = 2 mm; B, telson and right uropod; C, abdomen in lateral view; D, anterior carapace in dorsal view; E, pereopod 1, smaller chela; F, pereopod 1, larger chela; G, anterior carapace, ♀ cl 4.1 mm; H, anterior carapace, ♂ cl 3.4 mm; I, anterior carapace, ♂ cl 4.0 mm; J, anterior carapace, ♂ cl 4.1 mm.

batrossae. Maxilliped 3 with 2 posterodistal teeth on merus; ischial crest bearing about 25 denticles. Pereopod 1, larger chela with fingers about half length of upper palm of propodus, cutting edge of dactylus entire; propodal finger entire along outer edge, inner edge with rounded tubercle at about midlength. Pereopod 1, smaller chela with fingers slightly less than half length of propodal palm;

cutting edge of dactylus broadly undulating; cutting edge of propodal finger with rounded tubercle at about midlength, followed by few low tubercles. Uropod with lateral ramus having about 14 serrations on lateral margin, distomesial margin somewhat truncate, setose; mesial ramus with lateral margin and laterodistal angle having about 18 serrations, distomesial margin truncate, setose. Telson with basal width slightly less than greatest length, lateral margins with 5 teeth, short mobile posterolateral spine present, posterior margin convex, with short median spine.

Remarks.—Three species of *Eiconaxius* have been recorded from the western and central Pacific, none of which closely resemble *E. kimbla*: *E. singularis* Zarenkov, 1981, from the north-west Pacific possesses a narrowly lanceolate and finely dentate rostrum, lacks lateral carinae, and has distally broadly rounded (not angled) uropodal rami; *E. asper* Rathbun, 1906, from Hawaii possesses dentate rostral margins and median carina, and markedly differentiated chelae of pereopod 1; *E. kermadeci* Bate, 1888, from off the Kermadec Islands has dentate rostral margins, an entire median carina, elongate submedian carinae, and markedly differentiated chelae of pereopod 1.

Eiconaxius sibogae De Man, 1925 from the Sulu Sea off the Philippines most closely resembles *E. kimbla*: the telson is very similar, and has a mobile posterolateral spine; the uropodal rami show the same truncation of the distal margin (but not to the extent seen in *E. kimbla*), with the spinose posterodistal angle of the mesial ramus being produced (De Man, 1925, pl. 2, fig. 4d). The main differences between the two species lie in the rostral margins and the median carina, which are dentate in *E. sibogae,* unarmed in *E. kimbla,* and in the posterior margin of the merus of pereopod 1, which is serrate in *E. sibogae,* entire in *E. kimbla.*

Given the presence of a mobile posterolateral telsonic spine, and poorly differentiated chelae of pereopod 1, *E. kimbla* and *E. sibogae* would seem to be the most primitive members of the genus.

Etymology.—The specific name derives from the New South Wales Fisheries Vessel KIMBLA, from which the species was collected, and is used as a noun in apposition.

Marianaxius, new genus

Diagnosis.—Protandrous hermaphrodites probably occurring in population (♂ and ♀ apertures clearly visible on both specimens). Carapace lacking strong supraocular spine; post-cervical carina and spines lacking; rostrum slightly lower than anterior carapace; rostral margins armed; median carina entire; submedian carina lacking; lateral carina entire, short, posterior to rostral base.

Eye well pigmented, facets hexagonal; stalk rounded, slightly longer than eye. Antennal acicle a fairly well developed spike, less than half length of peduncle article 4. Maxilliped 3 ischial crest bearing about 20 denticles; merus with 3 teeth on posterior margin, distalmost largest. Pereopod 1, chelae asymmetrical, not sexually dimorphic; pereopod 2 chelate; pereopods 3–5, dactyli simple. Pleopodal rami slender-elongate; appendix interna lacking on all pleopods; pleopod 1 ♂ uniramous, uniarticulate, lacking patch of small hooks; pleopods 2 ♂ with strong appendix masculina, endopod of 1 article; pleopod 1 ♀ uniramous, uniarticulate, lacking patch of small hooks. Lateral ramus of uropod with suture. Telson longer than wide, with submedian dorsal non-articulating spines; row of 4 posterolateral articulating spines on each side.

Type species: By present designation, *Marianaxius kroppi,* new species. Type locality: Guam, 1–1.5 m. Gender: Masculine.

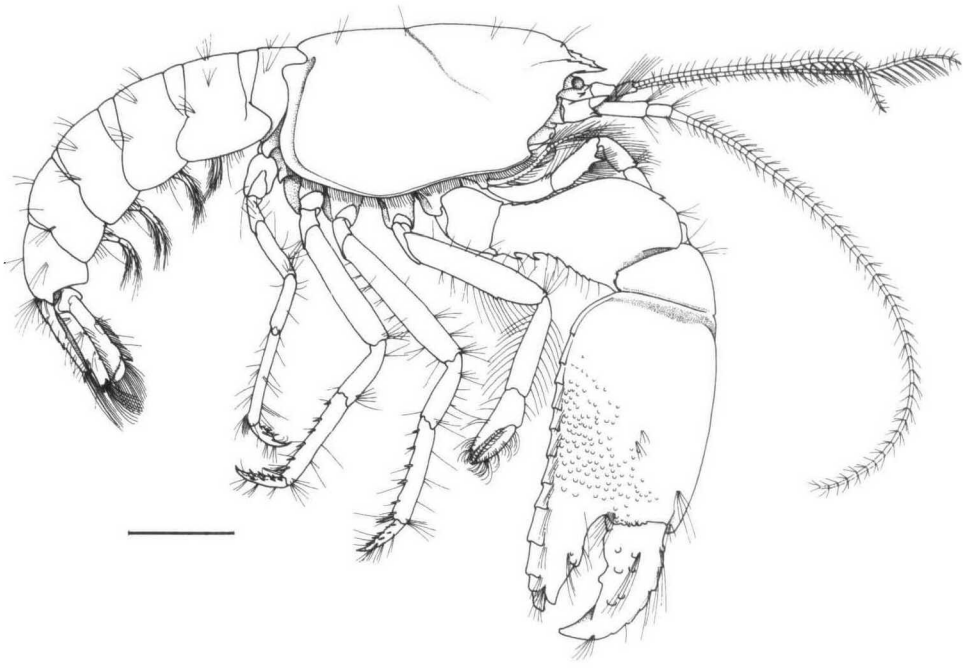

Figure 9. *Marianaxius kroppi,* holotype, USNM 243530, scale = 2 mm.

Remarks.—*Marianaxius* superficially appears most similar to *Paraxiopsis* (Kensley, 1995), especially in the lack of appendices internae on the pleopods. They differ, however, in that *Marianaxius* does not have a bifid shortened antennal scale, possesses pleopod 1 in the male (absent in *Paraxiopsis*), lacks a submedian carapace carina and spines, as well as a posteromedian telsonic spine, and possesses four posterolateral mobile telsonic spines (one present in *Paraxiopsis*).

Etymology.—The generic name is a combination of 'Marian-,' derived from the Mariana Islands, of which the type locality Guam is a member, plus the suffix 'axius,' denoting its membership of the Axiidae.

Marianaxius kroppi, new species
Figures 9, 10, Table 4

Material Examined.—Holotype, USNM 243530, ♂ cl 5.1 mm, GUM 245-A, Piti Bay, Guam, outer reef flat rubble to 1.5 m, coll. R. Kropp, 11 Jun 1986. *Paratype,* USNM 243531, ♀ cl 4.7 mm, GUM 208-B, Piti Bay, Guam, outer reef flat to 1 m, coll. R. Kropp, 18 May 1986.

Diagnosis.—Carapace surface, especially of branchiostegite, faintly pitted; 3 small lateral rostral teeth; median carina entire; lateral carina entire. Abdominal pleura ventrally rounded-truncate, with faint tooth on anterior margin of 3–5.

Antennular peduncle with articles 2 and 3 together slightly shorter than basal article. Antennal acicle spike-like, less than half length of peduncle article 4. Maxilliped 3, posterior margin of ischium faintly serrate, ischial crest having 20 teeth; merus with two small and one large distal tooth on posterior margin. Pereopod 1, larger chela with posterior margin of ischium faintly serrate; merus with 2–4 relatively large proximal spines followed by several low serrations and 2 large distal spines on posterior margin, single small distal spine on dorsal (anterior) margin; carpus unarmed; propodal palm about 1.6 times fingers in length,

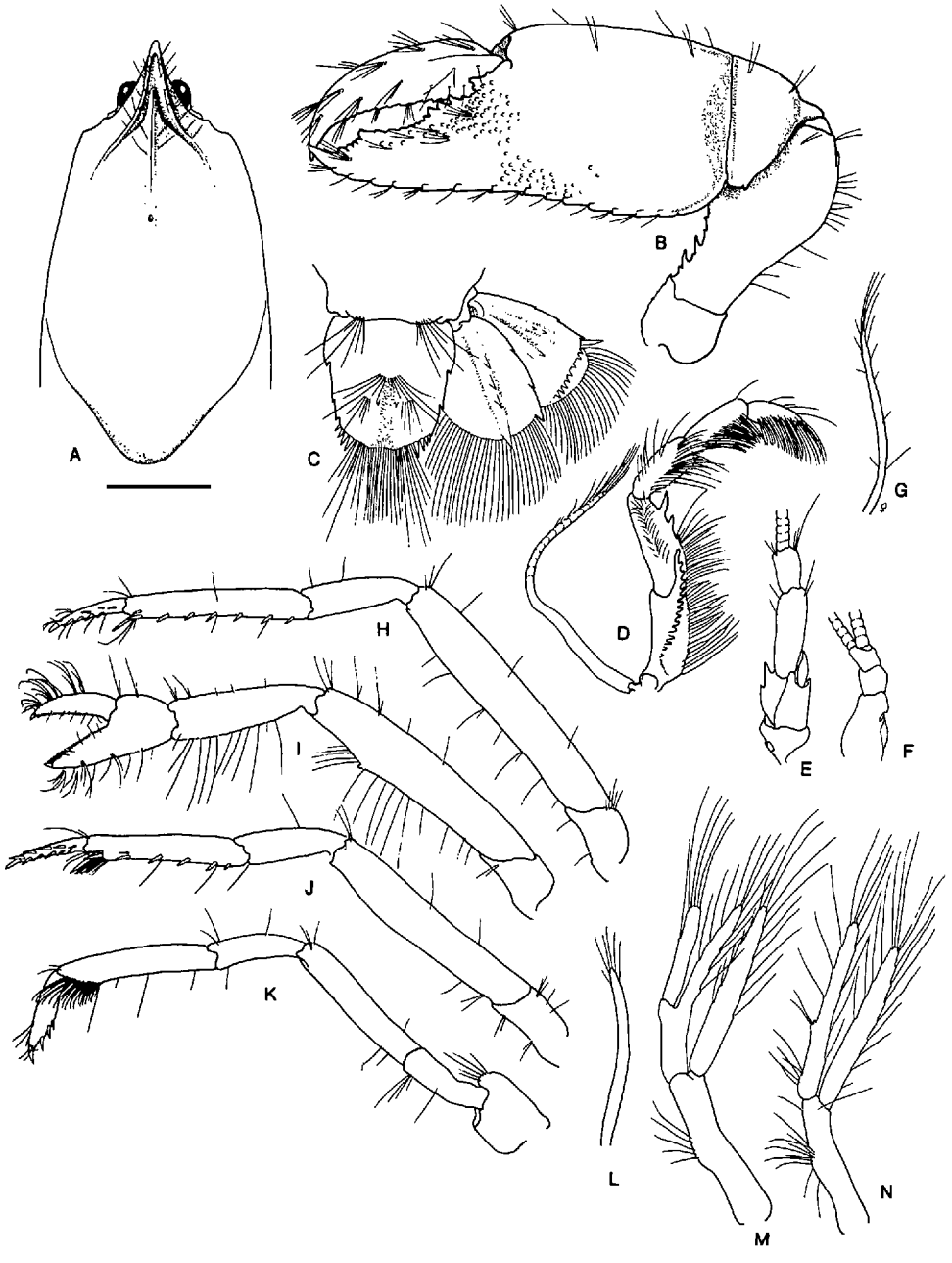

Figure 10. *Marianaxius kroppi*: A, anterior carapace in dorsal view; B, pereopod 1, larger chela; C, telson and right uropod; D, maxilliped 3, buccal view; E, antennal peduncle; F, antennular peduncle; G, pleopod 1 ♀; H, pereopod 3; I, pereopod 2; J, pereopod 4; K, pereopod 5; L, pleopod 1 ♂; M, pleopod 2 ♂; N, pleopod 3.

Table 4. Branchial and exopod formula for *Marianaxius kroppi*. r = rudimentary.

	Maxillipeds			Pereopods				
	1	2	3	1	2	3	4	5
Exopod	1	1	1	—	—	—	—	—
Epipod	1	1	1	1	1	1	1	—
Podobranch	—	—	r	r	r	r	—	—
Arthrobranch	—	—	2	2	2	2	2	—
Pleurobranch	—	—	—	—	—	—	—	—
Setobranch	—	—	1	1	1	1	1	—

lower margin to end of fixed finger with imbricate ridge, upper margin with very faint rounded ridge, outer surface granulate posterodistally, fixed finger with single tubercle at midlength of cutting edge, apex bifid; dactylus with upper margin faintly imbricate, cutting edge concave, with single tubercle at about midlength. Pereopod 1, smaller chela with ischium, merus, and carpus as in larger chela; propodal palm subequal in length to fingers, posterior margin to apex of fixed finger with imbricate ridge, outer surface granulate posterodistally, cutting edge of fixed finger irregularly dentate; dactylus with cutting edge serrate. Pereopod 2, merus with single small spine in distal half of posterior margin. Pereopods 3 and 4, propodus with 6 or 7 small mobile spines on posterior margin; dactyl with short mobile spines on posterior and lateral surfaces. Pereopod 5, propodus with distal cluster of stiff grooming setae. Lateral ramus of uropod with 3 spines, including spine at suture, strong mobile spine mesial to distal marginal spine, 8 small spines along suture, 2 or 3 spines on dorsal surface; mesial ramus with 3 spines on outer margin including distalmost spine, 4 dorsal spines on longitudinal ridge including distalmost marginal spine. Telson with one pair of submedian dorsal spines, 3 fixed lateral marginal spines, plus row of 4 mobile posterolateral spines.

Remarks.—There is uncertainty in this species regarding its reproductive strategy. Protandry possibly occurs, as both specimens show very clear male and female genital apertures, yet the "male" possesses a strong appendix masculina on pleopod 2, which the "female" lacks. Both specimens possess a simple slender rod-like uniarticulate pleopod 1.

Etymology.—The species is named for Dr. Roy Kropp of Battelle Ocean Sciences, who collected the material described here, along with several other thalassinidean species.

Family Calocarididae

Genus *Ambiaxius* Sakai and de Saint Laurent, 1989

Remarks.—Ambiaxius differs from the closely related *Calocaris* in several features: *Ambiaxius* lacks a postcervical median carina, the antennal acicle is a short spike, there is no broad gape between fingers of chela of pereopod 1, the appendix interna of pleopod 2 is fused with a spinose endopod; in *Calocaris* there is a strong postcervical median carina, the antennal acicle is very reduced or absent, there is a broad basal gape in the chela of pereopod 1, the appendix interna of pleopod 2 is free, and the distal endopod does not bear a series of spines. The gill structure perhaps shows the greatest difference between these two genera: *Calocaris* possesses normal trichobranch gills, while *Ambiaxius* has gills each reduced to a single lobe or lamella, i.e. lacking lateral branches. The distal article

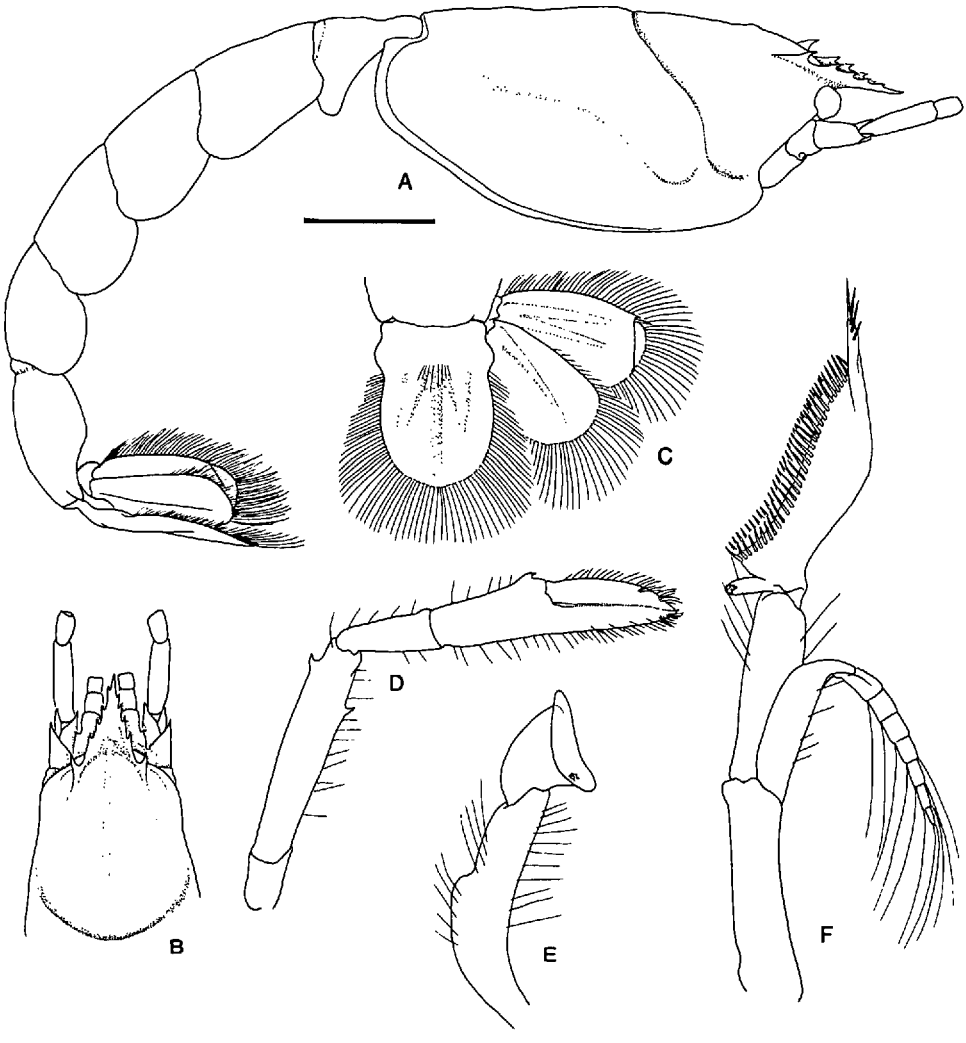

Figure 11. *Ambiaxius japonicus,* holotype, USNM 243401: A, carapace and abdomen in lateral view, scale = 3 mm; B, anterior carapace in dorsal view; C, telson and right uropod; D, pereopod 1; E, pleopod 1; F, pleopod 2.

of the endopod of pleopod 2 in *Ambiaxius* probably consists of the basally fused appendix interna, a spinose structure representing the fused appendix masculina, and a distally fused lobe representing the remnant of the endopodal ramus.

Species:

Ambiaxius aberrans (Bouvier, 1905). Off St. Lucia, Lesser Antilles, 809 m.
Ambiaxius alcocki (McArdle, 1901). Bay of Bengal, 992 m.
Ambiaxius cf. *alcocki* (McArdle, 1901). Southwest Indian Ocean, 1,000 m.
Ambiaxius japonicus, new species. Japan, 472 m.

Ambiaxius japonicus new species
Figure 11, Table 5

Material Examined.—Holotype, USNM 243401, hermaphrodite cl 9.4 mm, (eggs visible under carapace), ALBATROSS sta 5056, 12 Oct 1906, off Ose Saki, Japan, 34°58′40″N, 138°43′35″E, 472 m.

Table 5. Branchial and exopod formula for *Ambiaxius japonicus*. r = rudimentary.

	Maxillipeds			Pereopods				
	1	2	3	1	2	3	4	5
Exopod	1	1	1	—	—	—	—	—
Epipod	1	1	1	1	1	1	1	—
Podobranch	—	r	r	r	r	r	—	—
Arthrobranch	—	—	2	2	2	2	2	—
Pleurobranch	—	—	—	—	—	—	—	—
Setobranch	—	—	1	1	1	1	1	—

Diagnosis.—Carapace surface smooth; rostrum with 5 pairs lateral teeth; median carina entire, well marked; submedian carina barely marked; lateral carina obsolete posterior to proximalmost rostral tooth. Abdominal pleura ventrally rounded, that of somite 2 widest.

Maxilliped 3, merus with 2 strong distal spines on posterior margin; posterior margin of ischium unarmed. Pereopod 1 (left missing), merus bearing single distal spine on anterior and posterior margin; carpus unarmed, slightly shorter than propodal palm; latter subequal in length to fingers of chela, bearing single distal tooth on anterior margin; cutting margins of fingers contiguous along entire length, bearing fine spinules in distal halves. Pereopod 2, merus unarmed. Pleopod 1 of 2 articles, distal article expanded. Pleopod 2 with endopod of 2 articles, distal article consisting of basally fused appendix interna, large spinose fused appendix masculina, plus distal fused slender lobe representing remnant of endopod. Lateral uropodal ramus with single mobile spine mesial to small fixed margin spine, suture unarmed; mesial ramus, margins unarmed. Telson with margins lacking spines, dorsal surface lacking spines, posterior margin evenly convex.

Remarks.—The Japanese species differs from previously described species in having more lateral rostral spines than in *A. alcocki* and *A. aberrans*, and in having a squatter telson (midlength 1.5 times basal width, 1.9 times basal width in *A. alcocki*).

Etymology.—The specific name is derived from the type locality, Japan.

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Literature Cited

Alcock, A. 1901. A descriptive catalogue of the Indian deep-sea Crustacea Decapoda Macrura and Anomala, in the Indian Museum. Being a revised account of the deep-sea species collected by the Royal Indian Marine Survey Ship Investigator. Calcutta: Trustees of the Indian Museum. 286 p, 3 plates.

Bate, C. S. 1888. Report on the Crustacea Macrura collected by H.M.S. Challenger during the years 1873–1876.—Report on the Scientific Results of the Voyage of H.M.S. Challenger during the years 1873–76, Zoology 24: i-xc, 1–942.

Borradaile, L. A. 1903. On the classification of the Thalassinidea. Ann. Mag. Nat. Hist. (7)12: 534–551.

Bouvier, E. L. 1905. Sur les Thalassinides recueillis par le Blake dans la mer Antilles et le Golfe du Mexique.—Comp. Rend. Séanc. l'Acad. Scie, Paris, 141(31): 802–806.

———. 1925. Reports on the results of dredging under the supervision of Alexander Agassiz in the Gulf of Mexico (1877–78), in the Caribbean Sea (1878–79), and along the Atlantic coast of the United States (1880), by the U.S. Coast Survey Steamer "Blake", Lieut.-Com. C. D. Sigsbee, U.S.N., and Commander J. R. Bartlett, U.S.N., commanding. 48. Les Macroures Marcheurs.—Mem. Mus. Comp. Zoöl. Harvard College 47: 399–472.

de Man, J. G. 1905. Diagnosis of new species of macrurous decapod Crustacea from the "Siboga-Expedition".—Tijdschrift der Nederlandsche Dierkundige Vereeniging (2)9(3/4): 587–614.

———. 1907. Diagnoses of new species of macrurous decapod Crustacea from the "Siboga-Expedition". II.—Notes Leyden Mus. 29: 127–147.

———. 1925. The Decapoda of the Siboga-Expedition. Part VI. The Axiidae collected by the Siboga-Expedition.—Siboga Expeditie, monographe 39a5: 1–128.

Faxon, W. 1893. Reports on the dredging operations off the west coast of Central America to the Galapagos, to the west coast of Mexico, and in the Gulf of California, in charge of Alexander Agassiz, carried on by the U.S. Fish Commission Steamer "Albatross", during 1891, Lieut. Commander Z. L. Tanner, U.S.N., commanding. 6. Preliminary descriptions of new species of Crustacea.—Bull. Mus. Comp. Zoöl. Harvard College 24: 149–220.

———. 1895. Reports on an exploration off the west coasts of Mexico, Central and South America, and off the Galapagos Islands, in charge of Alexander Agassiz, by the U.S. Fish Commission Steamer "Albatross during 1891, Lieut.-Commander Z. L. Tanner, U.S.N., commanding. 15. The stalk-eyed Crustacea.—Mem. Mus. Comp. Zoöl. Harvard College 18: 1–292.

———. 1896. Reports on the results of dredging, under the supervision of Alexander Agassiz, in the Gulf of Mexico and the Caribbean Sea, and on the east coast of the United States, 1877–1880, by the U.S. Coast Survey Steamer "Blake", Lieut.-Commander C. D. Sigsbee, U.S.N., and Commander J. R. Bartlett, U.S.N., commanding. 37. Supplementary notes on the Crustacea.—Bull. Mus. Comp. Zoöl. Harvard College 30(3): 153–166.

Kensley, B. 1996. The genus *Paraxiopsis* De Man, with descriptions of new species from the Western Atlantic (Crustacea: Decapoda: Axiidae). Bull. Mar. Sci. 58: 709–729.

MacGilchrist, A. C. 1905. Natural history notes from the R.I.M.S. 'Investigator', Capt. T. H. Heming, R. N. (Retired), commanding. Series III, no. 6. An account of the new and some of the rarer decapod Crustacea obtained during the surveying seasons 1901–1904.—Annals and Magazine of Natural History (7)15: 233–268.

McArdle, A. F. 1901. Natural history notes from the Royal Indian Marine Survey Ship 'Investigator', Commander T. H. Heming, R. N., commanding. Series 3, No. 5. An account of the trawling operations during the surveying-season of 1900–1901.—Ann. Mag. Nat. Hist. (7)8: 517–526.

Milne Edwards, A. 1873. Description de quelques Crustacés nouveaux ou peu connus provenant du Musée de M. C. Godeffroy. J. Mus. Godeffroy 4: 77–88.

Ortmann, A. E. 1891. Die Decapoden-Krebse des Strassburger Museums. 3. Die Abtheilungen der Reptantia Boas: Homaridae, Loricata und Thalassinidea.—Zool. Jahrb. 6: 1–58.

Poore, G. C. B. 1994. A phylogeny of the families of Thalassinidea (Crustacea: Decapoda) with keys to families and genera.—Mem. Mus. Victoria 54: 79–120.

——— and D. J. G. Griffin. 1979. The Thalassinidea (Crustacea: Decapoda) of Australia. Rec. Austr. Mus. 32: 217–321.

Rathbun, M. J. 1906. The Brachyura and Macrura of the Hawaiian Islands.—Bull U.S. Fish Comm. 1903, 3: 827–930.

Sakai, K. 1992. Axiid collections of the Zoological Museum, Copenhagen, with the description of one new genus and six new species (Axiidae, Thalassinidea, Crustacea). Zool. Scripta 21: 157–180.

——— and M. de Saint Laurent. 1989. A check list of Axiidae (Decapoda, Crustacea, Thalassinidea, Anomura), with remarks, and in addition descriptions of one new subfamily, eleven new genera and two new species. Naturalists 3: 1–104.

Squires, H. J. 1977. A new species of *Axiopsis (Axiopsis)* (Thalassinidea, Axiidae) from the Pacific coast of Colombia. Canadian J. Zool. 55: 1885–1891.

Zarenkov, N. A. 1981. [*Axius (Eiconaxius) singularis* sp. n.] Pages 83–93 *in* N. A. Zarenkov and I. V. Khodkina, Decapoda, *in* A. P. Kuznetsov and A. N. Mironov, editors. Benthos of the submarine mountains Marcus-Necker and adjacent Pacific regions. Moscow, Academy of Sciences of the U.S.S.R., P. P. Shirshov Institute of Oceanology. 155 p. [In Russian, with Summary and Contents also in English]

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